350C/D
ATTENUATOR SET

OPERATING AND SERVICE MANUAL

HEWLETT hp PACKARD

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CERTIFICATION

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.

WARRANTY AND ASSISTANCE

All Hewlett-Packard products are warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period. No other warranty is expressed or implied. We are not liable for consequential damages.

For any assistance contact your nearest Hewlett-Packard Sales and Service Office. Addresses are provided at the back of this manual.

OPERATING AND SERVICE MANUAL

(HP PART NO. 00350-90202)

MODEL 350C/D ATTENUATOR SET

SERIALS PREFIXED: 220-

P. O. Box 301, Loveland, Colorado, 80537 U. S. A.

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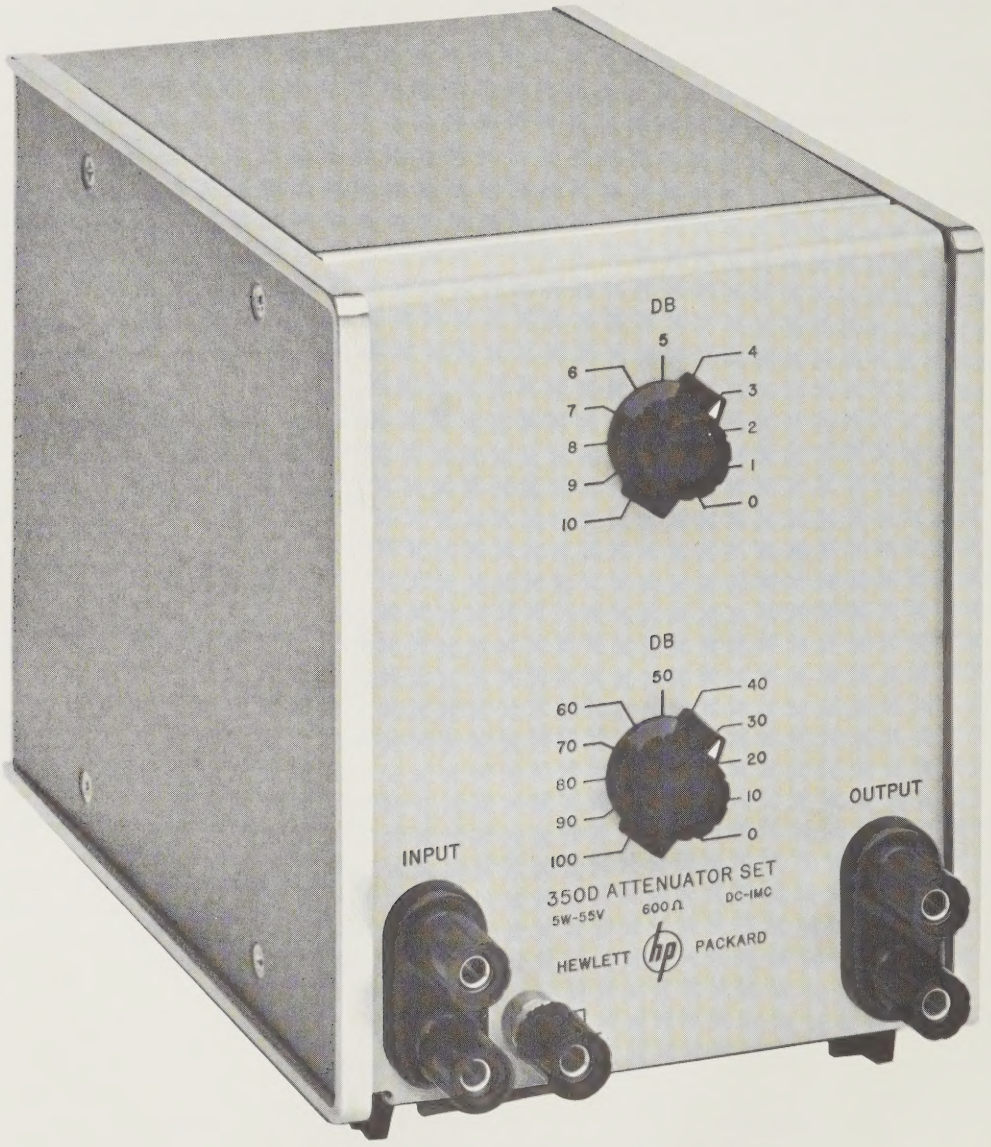


Figure 1-1. Model 350D Attenuator Set

SECTION I
GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. DIFFERENCE BETWEEN MODELS 350C AND 350D.

1-3. The basic difference between the Model 350C and Model 350D Attenuator Set is the input-output impedance value. The Model 350C has an input-output impedance of 500 ohms, and the Model 350D an input-output impedance of 600 ohms. Because of the similarity in design, use, circuitry and specifications, the two instruments are referred to as the Model 350C/D in this manual.

1-4. DESCRIPTION.

1-5. The Model 350C/D (Model 350D shown in figure 1-1) is an accurate, wide frequency range attenuator which provides attenuation from 0 db to a maximum of 110 db. Specifications for both instruments are given in table 1-1. The Model 350C/D will dissipate a maximum of 5 watts in continuous use with good accuracy from dc to 1 Mc. Each Model 350C/D consists of two sections: (1) 100 db adjustable in 10 db-steps, and (2) 10 db, adjustable in 1-db steps. The two sections are additive, allowing attenuation in 1-db or 10-db increments over the full 110-db range. A floating input is included which isolates the attenuator circuit ground from cabinet ground, allowing an ac input to be at a dc level.

1-6. The modular enclosure design allows convenient conversion from a bench model to a model which mounts in a standard 19-inch rack (see paragraph 2-5). The modular design provides the mechanical stability necessary for stacking instruments on a flat surface.

1-7. USES.

1-8. Wide frequency range, high power dissipation capability, and accuracy make the Model 350C/D useful in such applications as attenuating an oscillator output, checking gain and frequency response of an amplifier, and determining transmission loss. Use of the Model 350C/D is possible with a mismatched load or source impedance. Information on impedance matching networks and the attenuation losses involved are given in section III.

1-9. DIFFERENCES BETWEEN INSTRUMENTS.

1-10. The Hewlett-Packard Company uses a two-section, eight-digit serial number to identify instruments (e.g., 000-00000). The serial number is on a plate attached to the rear panel of the instrument. The first three digits are a serial prefix number, also appearing on the title page of this manual, and the last five digits refer to a specific instrument. If the first three digits of the instrument serial number are not the same as those on the title page, change sheets included with this manual will define any differences between other instruments and the Model 350C/D described herein. If the change sheets are missing, your Sales and Service Office can supply the information. (See Appendix B for office locations.)

Table 1-1. Specifications

ATTENUATION:
110 db in 1-db steps

ACCURACY, 10-DB SECTION:
From dc to 100 kc, error is less than ±0.125 db at any step; from 100 kc to 1 Mc, error is less than ±0.25 db at any step.

ACCURACY, 100-DB SECTION:
From dc to 100 kc, error is less than ±0.25 db at any step up to 70 db, less than ±0.5 db above 70 db; from 100 kc to 1 Mc, error is less than ±0.5 db at any step up to 70 db; less than ±0.75 db above 70 db.

POWER CAPACITY:
350C, 500 ohms: 5 watts (50 vdc or rms) maximum, continuous duty
350D, 600 ohms: 5 watts (55 vdc or rms) maximum, continuous duty

DIMENSIONS:
Module 6-3/32 in. high, 5-1/8 in. wide, 8 in. deep

WEIGHT:
Net 5 lb, shipping 7 lb

Table 3-1. Attenuation Factors

db	Attenuation Factor, A_f	db	Attenuation Factor, A_f	db	Attenuation Factor, A_f
0	1.0000	37	.01413	74	.0001995
1	.8913	38	.012590	75	.0001778
2	.7943	39	.011220	76	.00015850
3	.7079	40	.010000	77	.00014130
4	.6310	41	.008913	78	.00012590
5	.5623	42	.007943	79	.00011220
6	.5012	43	.007079	80	.00010000
7	.4467	44	.006310	81	.00008913
8	.3981	45	.005623	82	.00007943
9	.3548	46	.005012	83	.00007079
10	.3162	47	.004467	84	.00006310
11	.2818	48	.003981	85	.00005623
12	.2512	49	.003548	86	.00005012
13	.2239	50	.003162	87	.00004467
14	.1995	51	.002818	88	.00003981
15	.1778	52	.002512	89	.00003548
16	.1585	53	.002239	90	.00003162
17	.1413	54	.001995	91	.00002818
18	.1259	55	.001778	92	.00002512
19	.1122	56	.001585	93	.00002239
20	.1000	57	.001413	94	.00001995
21	.08913	58	.001259	95	.00001778
22	.07943	59	.001122	96	.00001585
23	.07079	60	.001000	97	.00001413
24	.06310	61	.0008913	98	.00001259
25	.05623	62	.0007943	99	.00001122
26	.05012	63	.0007079	100	.00001000
27	.04467	64	.0006310	101	.000008913
28	.03981	65	.0005623	102	.000007943
29	.03548	66	.0005012	103	.000007079
30	.03162	67	.0004467	104	.000006310
31	.02818	68	.0003981	105	.000005623
32	.02512	69	.0003548	106	.000005012
33	.02239	70	.003162	107	.000004467
34	.01995	71	.0002818	108	.000003981
35	.01778	72	.0002512	109	.000003548
36	.01585	73	.0002239	110	.000003162

SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the hp Model 350C/D Attenuator Set. Included are initial inspection procedures, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. The hp Model 350C/D Attenuator Set received a careful mechanical and electrical inspection before shipment. As soon as the Model 350C/D is received, verify that the contents are intact and as ordered. Although the instrument should be free of mars and scratches and in perfect electrical condition, it should be inspected for any physical damage which may have been incurred in transit. Also test the electrical performance of the instrument using the procedures given in Paragraph 5-10. If any physical damage or electrical deficiency is found, refer to the warranty on the inside front cover of this manual. Should shipping of the instrument become necessary, refer to Paragraph 2-11 for repackaging and shipping instructions.

2-5. INSTALLATION.

2-6. The Model 350C/D is a submodular unit suitable for bench top use. However, when used in combination with other submodular units it can be bench and/or rack mounted. The hp combining case and adapter frame are designed for this purpose.

2-7. COMBINING CASE.

2-8. The combining case is a full-module unit which accepts various combinations of submodular units. Being a full-module unit, it can be bench or rack mounted and is analogous to any full-module instrument.

2-9. ADAPTER FRAME.

2-10. The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your hp Sales and Service Office. (See Appendix B for office locations.)

2-11. REPACKAGING FOR SHIPMENT.

2-12. The following paragraphs contain a general guide for repackaging for shipment. Refer to Paragraph 2-13 if the original container is to be used; 2-14 if it is not. If you have any questions, contact your local hp Sales and Service Office.

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicate the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-13. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If original container is not available, one can be purchased from your nearest hp Sales and Service Office.

b. Ensure that the container is well sealed with strong tape or metal bands.

2-14. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Use packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE," etc.

SECTION III

OPERATING INSTRUCTIONS

3-1. OPERATING CONSIDERATIONS.

3-2. IMPEDANCE.

3-3. For full accuracy and ease of application, the source and load impedances should match the impedance at the INPUT and OUTPUT terminals of the Model 350C/D. When source and load impedances are the same as the impedance of the Model 350C/D, the amount of attenuation in the circuit is the sum of the two attenuator-knob settings. If an impedance-matching network is used (see Paragraph 3-12), the amount of insertion loss must be added to the Model 350C/D setting to obtain the amount of attenuation between source and load.

3-4. LEADS AND CONNECTIONS.

3-5. When making connections to the Model 350C/D and the other instruments in the test or measurement

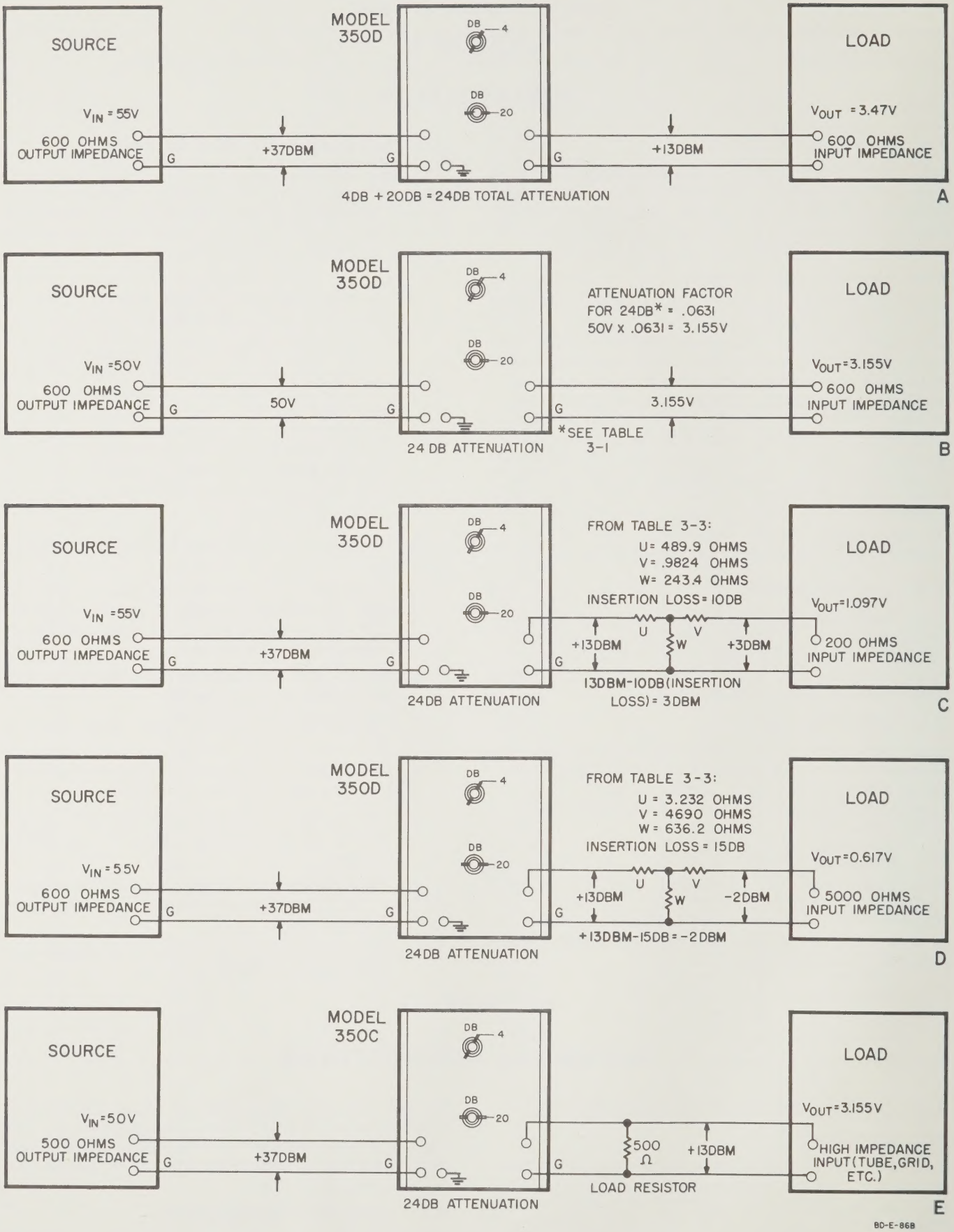


Figure 3-1. Model 350C/D Typical Applications

setup, use shielded (coaxial) leads as short in length as possible. Failure to use shielded leads may result in attenuation of a different value from that set on the Model 350C/D controls, especially at high attenuator settings and at frequencies above 100 kc. The shunting effect of stray capacitance (leads, terminals, etc.) is a factor at high frequencies unless shielded connections and short lead lengths are used. Three connectors at the INPUT terminals allow an ac input to be at a dc potential. Connect all inputs to the top and lower left INPUT terminals. If both input leads are shielded, connect the shield to the lower right terminal (marked ⏚) which is at cabinet ground potential. If an input is ac, but at some dc level, the load on the Model 350C/D must also be floating, i.e. not connected to cabinet ground potential (⏚).

3-6. INPUT POWER LIMITATION.

3-7. Do not apply more than 5 watts maximum to the Model 350C/D INPUT terminals. For the Model 350C (input impedance, 500 ohms), 5 watts corresponds to 50 volts (dc or rms): for the Model 350D (input impedance, 600 ohms), 5 watts corresponds to approximately 55 volts (dc or rms).

CAUTION

The Model 350C/D may be damaged by applying power to the OUTPUT terminals or by applying more than 5 watts to the INPUT terminals.

3-8. OPERATING PROCEDURES.

3-9. MATCHED IMPEDANCE.

3-10. When the Model 350C/D INPUT and OUTPUT terminals are terminated properly, attenuation is the sum of the 10 DB and the 100 DB control settings. The voltage at the output of the Model 350C/D may be determined if input voltage (or input db level) and the amount of attenuation inserted by the Model 350C/D are known. Table 3-1 shows the attenuation factor (A_f) over the attenuation range of the Model 350C/D. The method for finding the input level in dbm, is explained in Section IV. To find the voltage at the output terminals proceed as follows:

a. Determine the input voltage to the Model 350C/D and the amount of attenuation set on the Model 350C/D.

b. Locate the amount of attenuation in the db column of Table 3-1 and read the corresponding attenuation factor.

c. To calculate the output voltage, multiply the input voltage by the attenuation factor. See Paragraph 3-11 for an example.

3-11. In Figure 3-1 A and B the Model 350D is shown connected to a matching source and load. In both cases the Model 350D is set to attenuate the signal by 24 db. The attenuation factor for 24 db from Table 3-1 is 0.0631 and the output voltage, for the conditions shown in Figure 3-1A, is then:

$$V_{out} = (55v)\ (0.0631) = 3.47 \text{ volts}$$

For Figure 3-1B the attenuation factor is the same as for Figure 3-1A and the output voltage is:

$$V_{out} = (50v)\ (0.0631) = 3.155 \text{ volts}$$

3-12. USE OF IMPEDANCE-MATCHING NETWORK.

3-13. NEED FOR INPUT MATCH. An impedance-matching network is necessary between source and Model 350C/D attenuator under the following conditions:

a. Source frequency is 100 kc or above.

b. Model 350C/D is set for less than 20-db attenuation.

c. Source output frequency response is affected by mismatched impedance.

d. Source output is monitored by meter which is accurate only when source operates into matched load.

3-14. MATCHING AT THE INPUT.

a. When the source is not affected by mismatch and source impedance is lower than that of Model 350C/D, a series resistor may be used between source and attenuator. The resistor value should be the difference between Model 350C/D impedance and source impedance. For example, to match the Model 350C to a 200-ohm source requires a series resistance of 300 ohms.

b. Except for the condition stated in a., a resistive impedance-matching network should be used. Resistors should be deposited film or carbon type. Also, better accuracy is obtained if the network is enclosed in a shielded container and connecting leads are kept short. Data on impedance-matching networks for the Model 350C are given in Figure 3-2 and Table 3-2; data for the Model 350D are given in Figure 3-3 and Table 3-3. The amount of insertion loss is included in Tables 3-2 and 3-3.

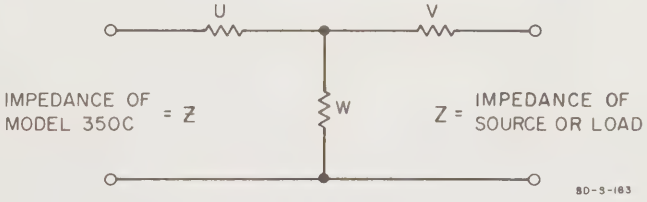


Figure 3-2. Model 350C Matching Network

Table 3-2. Model 350C Matching Network Values

Z (ohms)	Z (ohms)	U (ohms)	V (ohms)	W (ohms)	Insertion Loss
500	50	474.3	1.166	51.40	16 db
500	200	387.3	.8843	256.7	9 db
500	600	13.22	245.2	1148.0	4 db
500	2000	31.3	1733.0	536.2	12 db
500	5000	11.66	4743.0	514.1	16 db

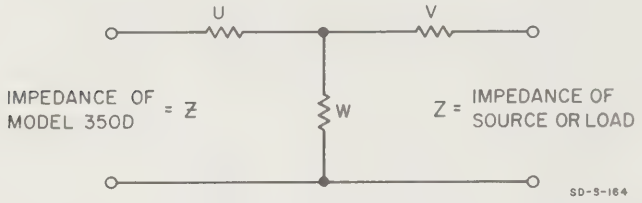


Figure 3-3. Model 350D Matching Network

3-15. NEED FOR OUTPUT MATCH. To maintain the rated attenuation accuracy of the Model 350C/D, the impedance of the load must match the output impedance of the Model 350C/D. When the load also must be terminated in its matching impedance, a resistive matching network must be used. When mismatch does not affect the load, under some conditions the required impedance match for the Model 350C/D can be obtained by use of a single resistor. Conditions under which a resistor can be used, and use of matching networks, are discussed below.

3-16. MATCHING AT THE OUTPUT.

a. When the impedance of the load is lower than that of the Model 350C/D and the load is not affected by a mismatch, impedance match for the Model 350C/D output can be obtained by inserting a series resistor between 350C/D output and load. Resistor value should be the difference between the Model 350C/D output impedance and the load impedance.

b. When the impedance of the load is much higher than that of the Model 350C/D, on the order of 50,000 ohms or more, impedance match for the Model 350C/D can be obtained by using a shunting resistor across the Model 350C/D output. For the Model 350C, the shunting resistor should be 500 ohms (see figure 3-1E), and for the Model 350D, 600 ohms.

c. Networks may be used which provide the Model 350C/D and its load with an impedance match. Network data and connections are given in figures 3-2 and 3-3 and tables 3-2 and 3-3. Figure 3-1C shows a network for matching a 200-ohm load and the 600-ohm Model 350D; figure 3-1D shows a network for matching a 500-ohm load and the 600-ohm Model 350D.

Table 3-3. Model 350D Matching Network Values

Z (ohms)	Z (ohms)	U (ohms)	V (ohms)	W (ohms)	Insertion Loss
600	50	574.5	2.111	49.92	17 db
600	200	489.9	.9824	243.4	10 db
600	500	245.2	13.22	1148.0	4 db
600	2000	33.06	1674.0	670.8	11 db
600	5000	3.232	4690.0	636.2	15 db

SECTION IV
PRINCIPLES OF OPERATION

4-1. GENERAL.

4-2. The Model 350C/D is shown in simplified schematic form in figure 4-1. In the complete schematic (figure 5-7) note that each attenuator section, 10 db and 100 db, is composed of four segments, each basically the same configuration as shown in figure 4-1. The attenuator circuit ground is isolated from the cabinet ground by capacitor C1, to allow a floating input, i.e. an ac signal at a dc level.

4-3. ATTENUATION EXPRESSED IN DECIBELS.

4-4. POWER AND VOLTAGE RATIOS.

4-5. The basic equation for computing attenuation in decibels is based on a power ratio where P = power, V = voltage, and R = resistance:

$$\text{no. of decibels} = 10 \log_{10}\left(\frac{P_1}{P_2}\right) \qquad (1)$$

Since power is expressed as: $P = \frac{V^2}{R}$ (2)

Equation (1) may be rewritten as:

$$\text{no. of db} = 10 \log_{10} \left(\frac{\frac{V_1{}^2}{R_1}}{\frac{V_2{}^2}{R_2}}\right) \qquad (3)$$

and if $R_1 = R_2$ then,

$$\text{no. of db} = 10 \log_{10} \left(\frac{V_1}{V_2}\right)^2 \qquad (4)$$

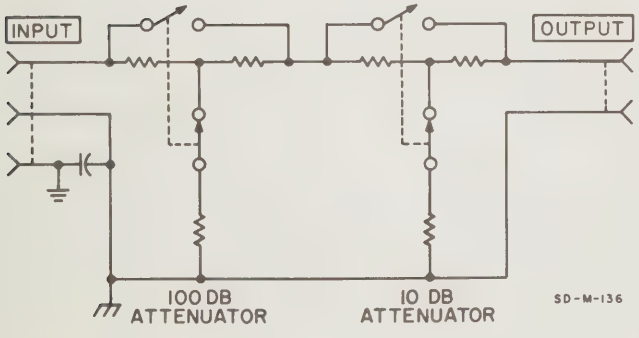


Figure 4-1. Model 350C/D Simplified Circuit

The basic rules for exponents of logarithms then allow equation (4) to be written as:

$$\text{no. of db} = 20 \log_{10} \left(\frac{V_1}{V_2}\right) \qquad (5)$$

4-6. The values of attenuation factor given in table 3-1 are based on a voltage ratio assuming the resistance at the input and output is the same. Values for A_f are computed using equation (5) where $V_1 = V_{in}$ and $V_2 = V_{out}$:

$$V_{out} = V_{in}A_f \quad \text{or} \quad \frac{V_{in}}{V_{out}} = \frac{1}{A_f} \qquad (6)$$

Then substituting equation (6) in equation (5) gives

$$\text{no. of db} = 20 \log_{10} \left(\frac{1}{A_f}\right) \qquad (7)$$

Solving for A_f gives

$$A_f = \frac{1}{\text{antilog}_{10} \frac{\text{no. of db}}{20}} \qquad (8)$$

An example will check the value for A_f given in table 3-1 to 24 db.

$$A_f = \frac{1}{\text{antilog}_{10}\left(\frac{24}{20}\right)} = \frac{1}{\text{antilog}_{10}(1.2)} \qquad (9)$$

From a log table, the antilog_{10} of 1.2 is 15.85 and

$$A_f = \frac{1}{15.85} = 0.0631 \qquad (10)$$

4-7. REFERENCE FOR DB.

4-8. The db levels given in figure 3-1 are referenced to a milliwatt of power, hence the term dbm. This indicates that the logarithm is taken of a power ratio where 1 milliwatt is the reference. For the 37 dbm shown in figure 3-1E, equations (1) and (2) show that:

$$\text{dbm} = 10 \log_{10} \frac{\left(\frac{50^2}{500}\right)}{1 \text{ milliwatt}}$$

$$\text{dbm} = 10 \log_{10} (5000) = 10\ (3.7) = 37$$

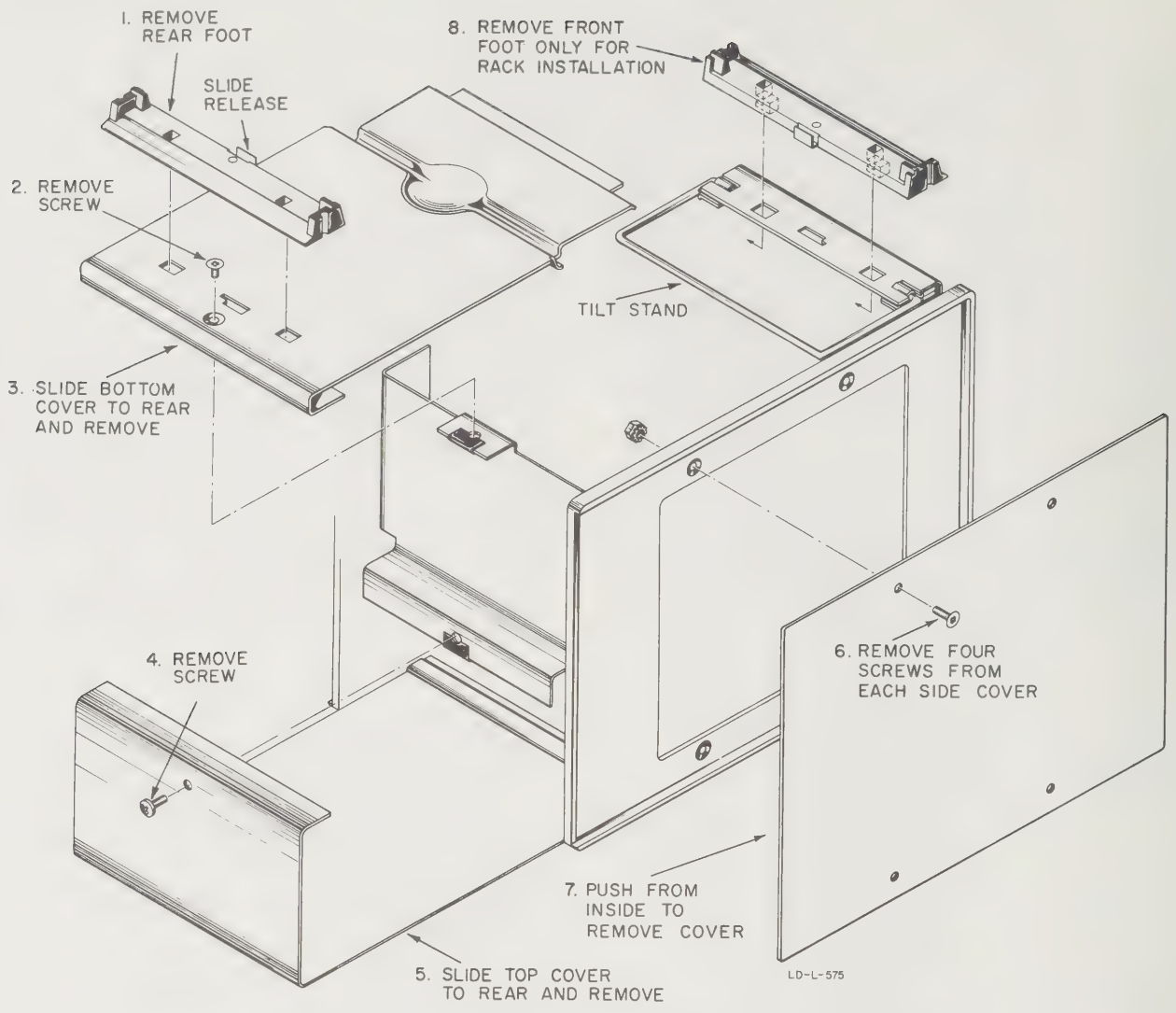


Figure 5-1. Cabinet Removal

Table 5-1. Test Equipment Required

Instrument Type	Required Characteristics	Use	Recommended Model
Power Supply	Output Voltage: 50 to 55 v Load Regulation: Less than 5 mv change at output terminals for 0 to 2 amperes change	DC Performance Test	℗ Model 726AR Power Supply
DC Voltage	Accuracy: ±1% full scale Ranges: 1 mv to 100v, 11 ranges	DC Performance Test	℗ Model 412A DC Voltmeter
Oscillator	Output Frequency: 100 kc and 1 Mc Output Voltage: 6 volt rms	AC Performance Test	℗ Model 651A Test Oscillator
Amplifier	Voltage Gain: 10 Frequency Range: 100 kc to 1 Mc	AC Performance Test	Krohn-Hite DCA-10 Wide Band Amplifier
AC Voltmeter	Accuracy: ±2% full scale (Para. 5-14) Ranges: -60 db to +40 db, 11 ranges Battery operated	AC Performance Test	℗ Model 403B/Option 01 AC Voltmeter

SECTION V
MAINTENANCE

5-1. INTRODUCTION.

5-2. Maintenance of the Model 350C/D should be minimal unless an overload voltage or physical damage requires replacement of a part. To prevent possible leakage across terminals at high frequencies, keep the instrument free of dust. The attenuator shaft bushings under the front panel DB knobs should be lubricated annually with one drop of light machine oil. Figure 5-7 is a schematic diagram for the Model 350C/D.

5-3. INSTRUMENT COVER REMOVAL.

5-4. Figure 5-1 illustrates the removal of all instrument covers. This should be necessary only when replacing an attenuator section or a switch component (see paragraphs 5-5 and 5-7).

5-5. COMPONENT REPLACEMENT.

5-6. REMOVAL OF ATTENUATORS.

5-7. Figure 5-2 illustrates the Model 350C/D with rear panel removed and identifies the components and assemblies. To remove the attenuator assemblies, proceed as follows:

a. Remove all instrument covers (see figure 5-1).

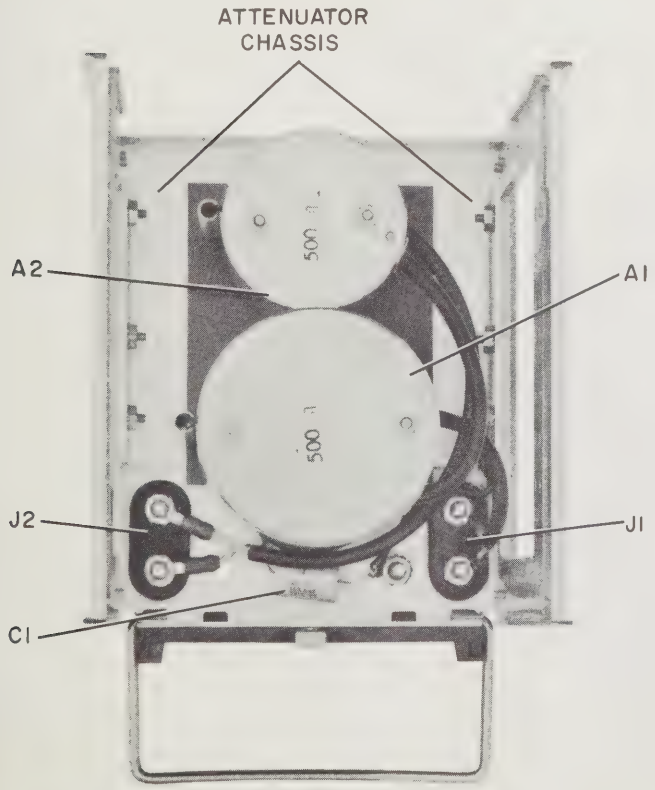


Figure 5-2. Model 350C/D Rear View (Rear Panel Removed)

b. Loosen screws in both attenuator knobs and remove knobs.

c. Disconnect coaxial cables from connectors J1 and J2 (see figure 5-2). Mark cables for proper reinstallation. Remove capacitor C1 lead from ground lug.

d. Remove flathead screws which fasten attenuator chassis (see figure 5-2) to instrument side castings. Remove attenuator chassis from instrument frame.

e. Remove switch shaft nuts holding assemblies to attenuator chassis.

f. Remove the slotted metal sleeve which clamps each shield around the attenuator assembly. To completely remove shield, unsolder the coaxial lead between the two attenuators; use care to avoid damage to cable insulation. This frees each attenuator for individual repair or replacement.

g. Reassembly is essentially the reverse of the above procedure.

5-8. REPLACEMENT OF RESISTORS.

5-9. Figure 5-3 identifies the resistors on the 100 db attenuator, A1, and figure 5-4 on the 10 db attenuator, A2. Replacement resistors may be ordered from the parts information in section VI. When a resistor is replaced, a padding resistor may be necessary to restore calibration accuracy.

5-10. DC PERFORMANCE TEST.

5-11. The dc performance test setup is illustrated in Figure 5-5. A DC Power Supply (hp Model 726AR) and a DC Voltmeter (hp Model 412A) are required for this test. In addition, a Corning Glass Works Co. 500 ohm, 10 watt, LPI-10 ±2% resistor is required for the 350C (600 ohm, 10 watt, LPI-10 ±2% for the 350D). This resistor must be enclosed in a shield as shown in Figure 5-5.

5-12. To perform the dc performance test, proceed as follows:

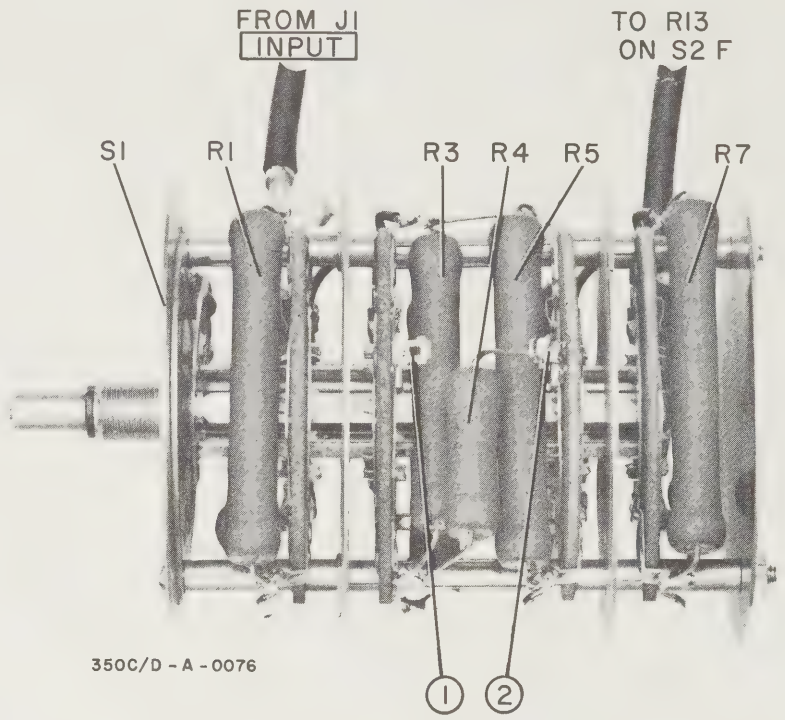
a. Make test setup illustrated in Figure 5-5.

b. Make control settings indicated in Step 1 of Table 5-2.

c. Adjust DC Power Supply for 50 volt indication on DC Voltmeter for 350C (55 volts for 350D).

d. Make control settings indicated in Step 2 of Table 5-2; if DC Voltmeter does not deflect to same position as in Step c ±tolerance listed for Step 2, perform calibration procedure contained in Paragraph 5-16.

e. Repeat Step d for remaining steps of Table 5-2.



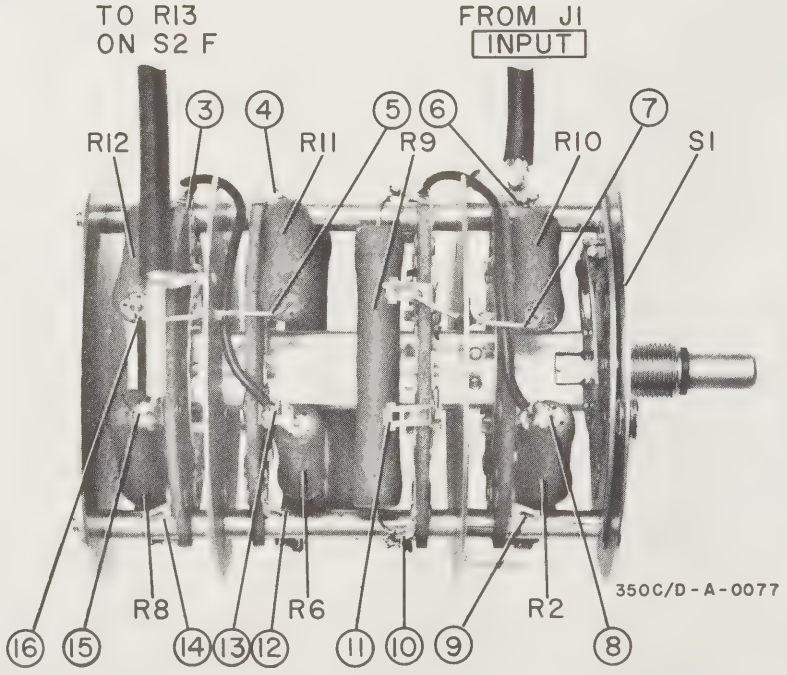
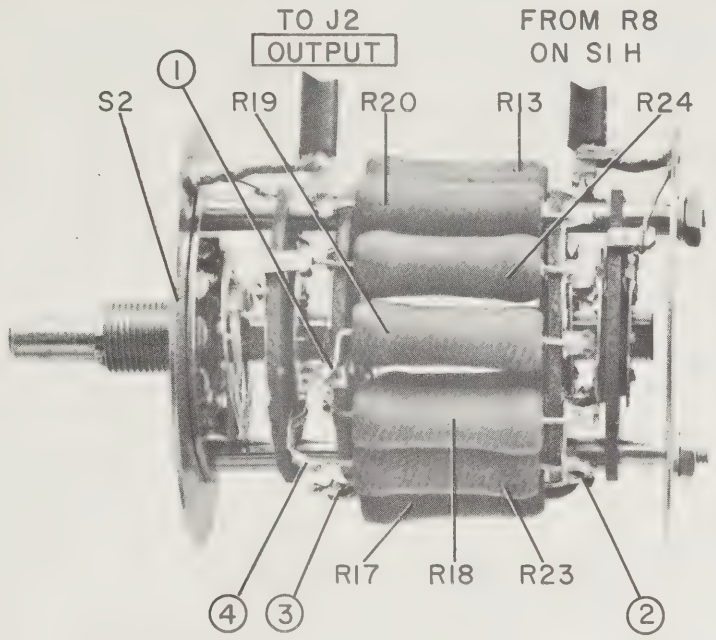


Figure 5-3. Assembly A1 Component Identification.



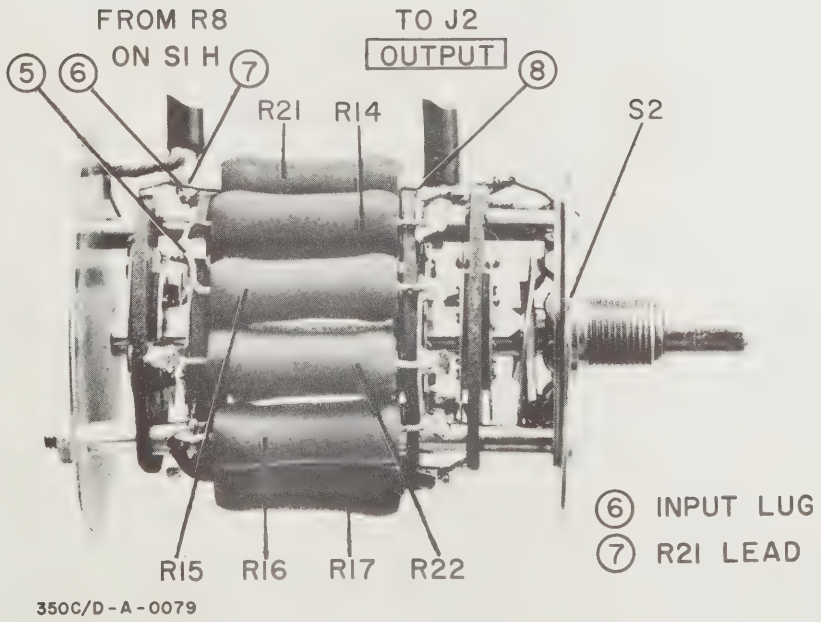


Figure 5-4. Assembly A2 Component Identification

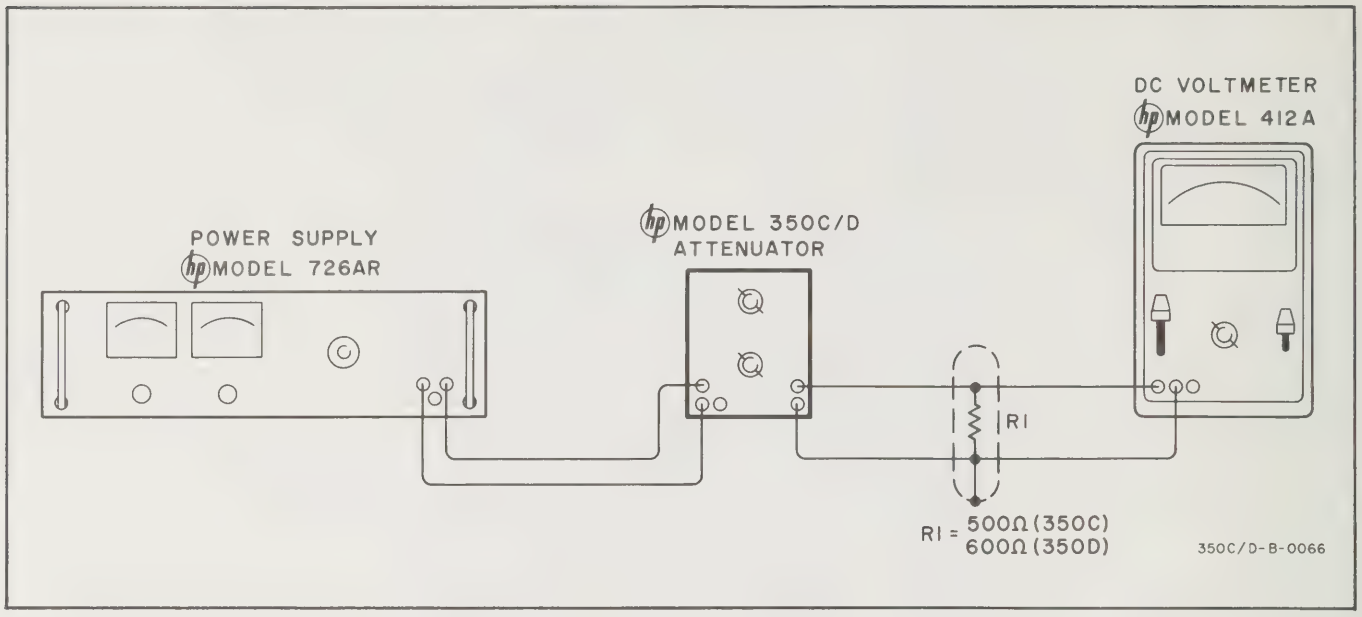


Figure 5-5. DC Performance Test Setup

Table 5-2. DC Performance Test, Supplemental Data

Step	350C/D Attenuator Setting	DC Voltmeter Volts Range	Tolerance	
			350C	350D
1	0	100		
2	10	30	±.45 v	±.51 v
3	20	10	±.15 v	±.17 v
4	30	3	± 45 mv	± 51 mv
5	40	1	± 15 mv	± 17 mv
6	50	.3	±4.5 mv	±5.1 mv
7	60	.1	±1.5 mv	±1.7 mv
8	70	.03	±.45 mv	±.51 mv
9	80	.01	±.30 mv	±.34 mv
10	90	.003	± 90 μv	±100 μv
11	100	.001	± 30 μv	± 34 μv

5-13. AC PERFORMANCE TEST.

5-14. The ac performance test setup is illustrated in Figure 5-6. An Oscillator (HP Model 651A), an Amplifier (Krohn-Hite DCA-10), and a battery operated AC Voltmeter (HP Model 403B) are required for this test. In addition, 2 Corning Glass Works Co. 500 ohm, 10 watt, LPI-10 ±2% resistors are required for the 350C (one 500 ohm and one 600 ohm, 10 watt, LPI-10 ±2% resistors for the 350D). These resistors must be enclosed in a shield as shown in Figure 5-6. The range-to-range accuracy of the AC Voltmeter from +40 db to -60 db must be known to within 0.1 db at 100 kc and 1 Mc. Any errors should be algebraically subtracted from the error found during the performance test.

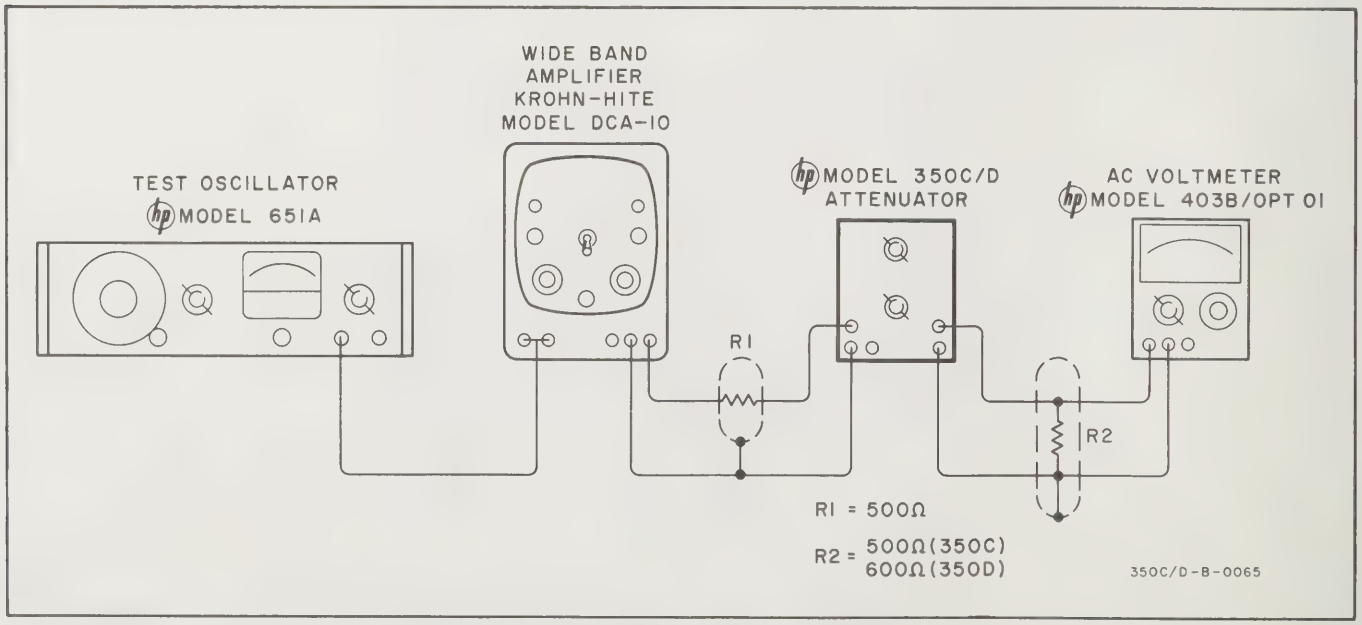


Figure 5-6. AC Performance Test Setup

5-15. To perform the ac performance test, proceed as follows:

a. Make test setup illustrated in Figure 5-6.

b. Make control settings indicated in Step 1 of Table 5-3.

c. Set Wide Band Amplifier for maximum gain.

d. Adjust Oscillator AMPLITUDE control for convenient reference on AC Voltmeter.

e. Make control settings indicated in Step 2 of Table 5-3; if AC Voltmeter does not indicate same as reference ± tolerance listed in Table 5-3, perform calibration procedure contained in Paragraph 5-16.

f. Repeat Step e for Steps 3 thru 11 of Table 5-3.

g. Set 350C/D for 50 db; AC Voltmeter for -20 db. Adjust Oscillator AMPLITUDE control for +2 db indication on AC Voltmeter.

h. Change 350C/D Attenuation to 60 db in 1 db steps; if AC Voltmeter does not indicate 1 (±0.125) db change for each step, perform calibration procedure contained in Paragraph 5-16.

i. Make control settings indicated in Step 12 of Table 5-3.

j. Adjust Oscillator AMPLITUDE control for convenient reference as indicated on AC Voltmeter.

k. Make control settings indicated in Step 13 of Table 5-3; if AC Voltmeter does not indicate same as reference ± tolerance listed in Table 5-3, perform calibration procedure contained in Paragraph 5-16.

l. Repeat Step e for Step 14 thru 22.

m. Repeat Step g.

n. Change 350C/D Attenuation to 60 db in 1 db steps; if AC Voltmeter does not indicate 1 (±0.25) db change for each step, perform calibration procedure contained in Paragraph 5-16.

Table 5-3. AC Performance Test, Supplemental Data

Step	Oscillator Frequency	350C/D DB Setting	AC Voltmeter DB Range	Tolerance in DB
1	100 kc	0	+40	
2	100 kc	10	+30	±0.25
3	100 kc	20	+20	±0.25
4	100 kc	30	+10	±0.25
5	100 kc	40	0	±0.25
6	100 kc	50	-10	±0.25
7	100 kc	60	-20	±0.25
8	100 kc	70	-30	±0.25
9	100 kc	80	-40	±0.5
10	100 kc	90	-50	±0.5
11	100 kc	100	-60	±0.5
12	1 Mc	0	+40	
13	1 Mc	10	+30	±0.5
14	1 Mc	20	+20	±0.5
15	1 Mc	30	+10	±0.5
16	1 Mc	40	0	±0.5
17	1 Mc	50	-10	±0.5
18	1 Mc	60	-20	±0.5
19	1 Mc	70	-30	±0.5
20	1 Mc	80	-40	±0.75
21	1 Mc	90	-50	±0.75
22	1 Mc	100	-60	±0.75

5-16. CALIBRATION PROCEDURE.

5-17. The calibration procedure comprises the addition of padding resistors to the attenuator switches. This procedure should be performed only when one of the attenuators is found to be out of tolerance. Table 5-4 contains the information necessary to pad the 10 db attenuator. Table 5-5 contains the information necessary to pad the 100 db attenuator.

5-18. Attenuation values above 40 db are obtained by the combination of the 10, 20, 30, and 40 db attenuators. The error on any one of these steps might be within tolerance, with the combination of two or more being out of tolerance. Therefore, padding resistor values are given in Tables 5-4 and 5-5 for errors which are by themselves, not out of tolerance.

5-19. To perform the calibration procedure, find the value of padding resistor which corresponds to the magnitude and direction of error. Add this resistor between the points indicated. Check the calibration by performing the appropriate performance test.

Table 5-4. 1 DB Step Attenuator Padding Data

1 DB Step Attenuator Position	Magnitude and Direction of Error			Padding Resistor				Ref Des	Position on S2 (See Figure 5-4)
				350C		350D			
	0-0.05	0.05-0.075	0.075-0.1	Value	hp Stock No.	Value	hp Stock No.		
3	+			6.2K	0758-0046	7.5K	0758-0047	R37	7-8
3	-			8.2K	0758-0048	10K	0758-0006	R36	5-6
3		+		3.9K	0758-0045	4.7K	0758-0005	R37	7-8
3		-		5.6K	0758-0057	6.8K	0758-0009	R36	5-6
3			+	2.7K	0758-0004	3.3K	0758-0010	R37	7-8
3			-	4.3K	0758-0071	5.1K	0758-0037	R36	5-6
4	+			12K	0758-0012	15K	0758-0018	R41	2-4
4	-			15K	0758-0018	18K	0758-0019	R40	1-3
4		+		7.5K	0758-0047	9.1K	0758-0038	R41	2-4
4		-		10K	0758-0006	12K	0758-0012	R40	1-3
4			+	5.6K	0758-0057	6.8K	0758-0009	R41	2-4
4			-	7.5K	0758-0047	9.1K	0758-0038	R40	1-3

Table 5-5. 10 DB Step Attenuator Padding Data

10 DB Step Attenuator Position	Magnitude and Direction of Error						Padding Resistor				Ref Des	Position on S1 (See Figure 5-3)
							350C		350D			
	0.1-0.15	0.15-0.2	0.2-0.25	0.25-0.3	0.3-0.35	0.35-0.4	Value	℗ Stock No.	Value	℗ Stock No.		
10	+						5.6K	0758-0057	6.8K	0758-0009	R27	10-11
10	-						27K	0758-0074	33K	0758-0049	R26	1-2
10		+					3.9K	0758-0045	4.7K	0758-0005	R27	10-11
10		-					20K	0758-0039	24K	0758-0073	R26	1-2
10			+				3.3K	0758-0010	3.9K	0758-0045	R27	10-11
10			-				16K	0758-0072	20K	0758-0039	R26	1-2
20	+						3.9K	0758-0045	4.7K	0758-0005	R31	4-5
20	-						130K	0758-0065	162K	0757-0130	R28	12-13
20		+					3.0K	0758-0035	3.6K	0758-0036	R31	4-5
20		-					100K	0758-0053	120K	0758-0061	R28	12-13
20			+				2.4K	0758-0034	2.7K	0758-0004	R31	4-5
20			-				82K	0758-0022	100K	0758-0053	R28	12-13
20				+			2.0K	0758-0033	2.4K	0758-0034	R31	4-5
20				-			68K	0758-0019	82K	0758-0022	R28	12-13
20					+		1.6K	0758-0063	2K	0758-0033	R31	4-5
20					-		62K	0758-0075	75K	0758-0075	R28	12-13
30	+						1.5K	0758-0017	1.8K	0758-0043	R30	6-7
30	-						422K	0757-0134	511K	0757-0135	R25	8-9
30		+					1.2K	0758-0070	1.5K	0758-0017	R30	6-7
30		-					332K	0757-0132	383K	0757-0133	R25	8-9
30			+				910	0758-0068	1.1K	0758-0069	R30	6-7
30			-				274K	0757-0131	332K	0757-0132	R25	8-9
30				+			750	0758-0067	910	0758-0068	R30	6-7
30				-			215K	0757-0127	274K	0757-0131	R25	8-9
30					+		620	0758-0066	750	0758-0067	R30	6-7
30					-		178K	0757-0129	215K	0757-0127	R25	8-9
30						+	560	0758-0002	680	0758-0031	R30	6-7
30						-	162K	0757-0130	200K	0757-0128	R25	8-9
40	+						510	0758-0030	620	0758-0066	R32	3-16
40	-						1.33M	0757-0140	1.62M	0728-0001	R29	14-15
40		+					390	0758-0008	470	0758-0029	R32	3-16
40		-					1.1M	0757-0139	1.33M	0757-0140	R29	14-15
40			+				330	0758-0054	390	0758-0008	R32	3-16
40			-				909K	0757-0138	1.1M	0757-0139	R29	14-15
40				+			240	0758-0023	300	0758-0016	R32	3-16
40				-			750K	0757-0137	909K	0757-0138	R29	14-15
40					+		220	0758-0015	270	0758-0028	R32	3-16
40					-		619K	0757-0136	750K	0757-0137	R29	14-15
40						+	180	0758-0014	220	0758-0015	R32	3-16
40						-	511K	0757-0135	619K	0757-0136	R29	14-15

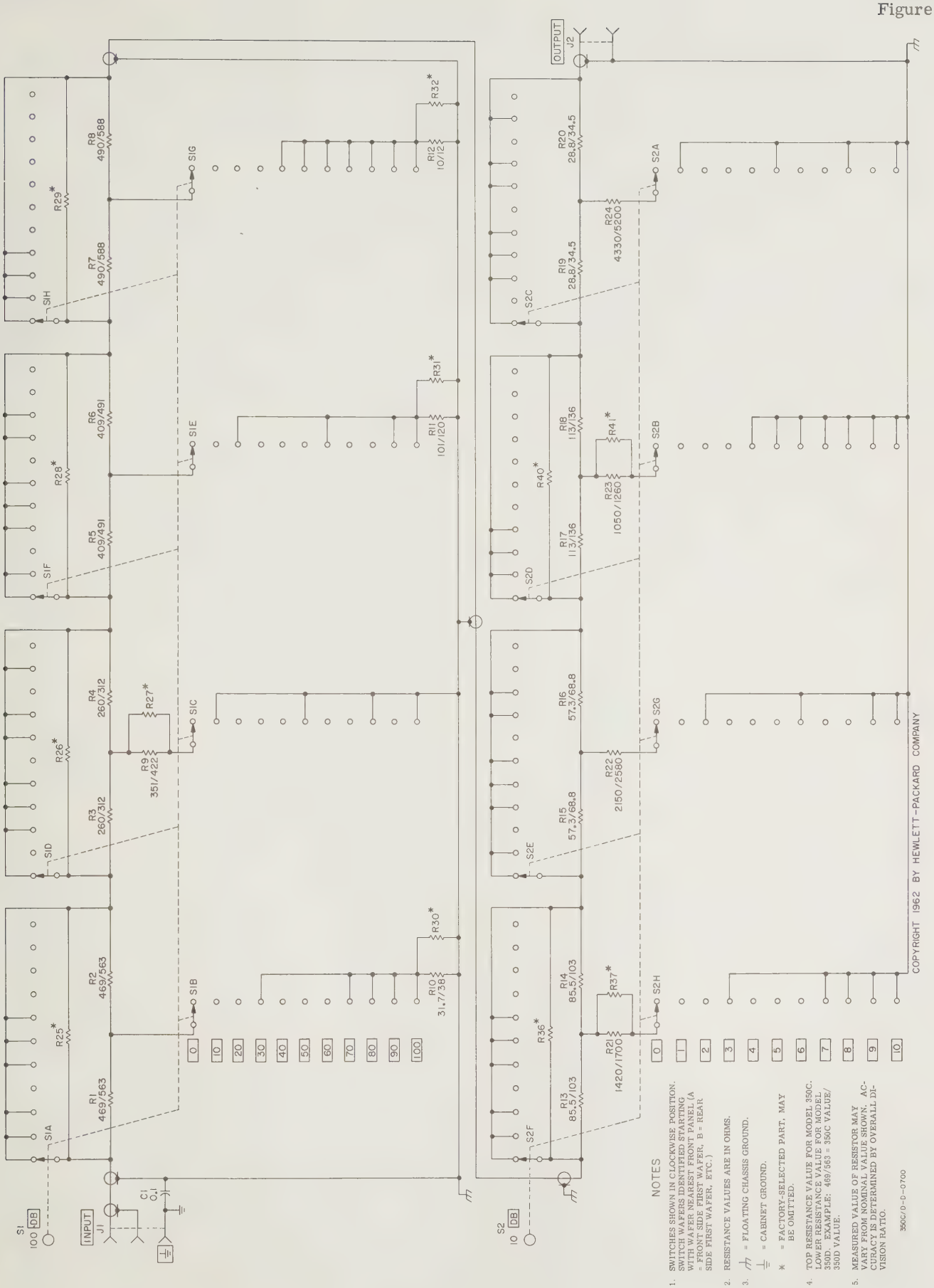


Figure 5-7. Model 350C/D Schematic Diagram

SECTION VI
REPLACEABLE PARTS

6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and ℎ stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their ℎ stock number and provides the following information on each part:

a. Description of the part (see list of abbreviations below).

b. Typical manufacturer of the part in a five-digit code (see list of manufacturers in Appendix).

c. Manufacturer's part number.

d. Total quantity used in the instrument (TQ column).

6-3. Miscellaneous parts are listed at the end of Table 6-1.

6-4. ORDERING INFORMATION.

6-5. To obtain replacement parts, address order or inquiry to your local Hewlett-Packard Field Office (see maps at rear of this manual for addresses). Identify parts by their Hewlett-Packard stock numbers.

6-6. NON-LISTED PARTS.

6-7. To obtain a part that is not listed, include:

a. Instrument model number.

b. Instrument serial number.

c. Description of the part.

d. Function and location of the part.

REFERENCE DESIGNATORS

A = assembly	F = fuse	P = plug	V = vacuum tube, neon bulb, photocell, etc.
B = motor	FL = filter	Q = transistor	W = cable
C = capacitor	J = jack	R = resistor	X = socket
CR = diode	K = relay	RT = thermistor	XF = fuseholder
DL = delay line	L = inductor	S = switch	XDS = lampholder
DS = device signaling (lamp)	M = meter	T = transformer	Z = network
E = misc electronic part	MP = mechanical part		

ABBREVIATIONS

A = amperes	F = farads	NC = normally closed	S-B = slow-blow
BP = bandpass	FXD = fixed	NE = neon	SE = selenium
BWO = backward wave oscillator	GE = germanium	NO = normally open	SECT = section(s)
	GL = glass	NPO = negative positive zero (zero temperature coefficient)	SI = silicon
CER = ceramic	GRD = ground(ed)		SIL = silver
CMO = cabinet mount only	H = henries	NSR = not separately replaceable	SL = slide
COEF = coefficient	HG = mercury		TA = tantalum
COM = common	HR = hour(s)	OBD = order by description	TD = time delay
COMP = composition	IMPG = impregnated		TI = titanium dioxide
CONN = connection	INCD = incandescent	P = peak	TOG = toggle
CRT = cathode-ray tube	INS = insulation (ed)	PC = printed circuit board	TOL = tolerance
DEPC = deposited carbon	K = kilo = 1000	PF = picofarads = 10^{-12} farads	TRIM = trimmer
EIA = Tubes or transistors meeting Electronic Industries' Association standards will normally result in instrument operating within specifications; tubes and transistors selected for best performance will be supplied if ordered by ℎ stock numbers.	LIN = linear taper	PP = peak-to-peak	TWT = traveling wave tube
	LOG = logarithmic taper	PIV = peak inverse voltage	U = micro = 10^{-6}
	M = meg = 10^{6}	POR = porcelain	VAC = vacuum
	MA = milliamperes	POS = position(s)	VAR = variable
	MINAT = miniature	POLY = polystyrene	W/ = with
	METFLM = metal film	POT = potentiometer	W = watts
	MFR = manufacturer	RECT = rectifier	WW = wirewound
ELECT = electrolytic	MTG = mounting	ROT = rotary	W/O = without
ENCAP = encapsulated	MY = mylar	RMS = root-mean-square	* = optimum value selected at factory, average value shown (part may be omitted)
		RMO = rack mount only	# = number

01194-5

Table 6-1. Reference Designation Index

REFERENCE DESIGNATION	℔ STOCK NO.	DESCRIPTION	NOTE
		MODEL 350C	
A1	350C-34B	Assy, attenuator, 0-100 db, includes: R1 thru R12, R25 thru R32, S1	
A2	350C-34A	Assy, attenuator, 0-100 db, includes: R13 thru R24, R36 thru R43, S2	
C1	0170-0022	C: fxd, my, 0.1 μf ±20%, 600 vdcw	
J1		Connector: INPUT, includes:	
	5060-0634	Assy, binding post: red	
	5060-0635	Assy, binding post: black	
	0340-0086	Insulator, binding post: 2 hole (outside)	
	0340-0090	Insulator, binding post: 2 hole, keyed (inside)	
	120A-47A	Spacer: binding post	
J2		Connector: OUTPUT, includes:	
	5060-0634	Assy, binding post: red	
	5060-0635	Assy, binding post: black	
	0340-0086	Insulator, binding post: 2 hole (outside)	
	0340-0090	Insulator, binding post: 2 hole, keyed (inside)	
R1	0775-0005	R: fxd, mfgl, 469 ohms ±2%, 7 w	
R2	0766-0028	R: fxd, mfgl, 469 ohms ±2%, 3 w	
R3	0772-0003	R: fxd, mfgl, 260 ohms ±2%, 5 w	
R4	0766-0024	R: fxd, mfgl, 260 ohms ±2%, 3 w	
R5	0775-0004	R: fxd, mfgl, 409 ohms ±2%, 7 w	
R6	0766-0026	R: fxd, mfgl, 409 ohms ±2%, 3 w	
R7	0775-0006	R: fxd, mfgl, 490 ohms ±2%, 7 w	
R8	0766-0030	R: fxd, mfgl, 490 ohms ±2%, 3 w	
R9	0772-0004	R: fxd, mfgl, 351 ohms ±2%, 5 w	
R10	0766-0027	R: fxd, mfgl, 31.7 ohms ±2%, 3 w	
R11	0766-0025	R: fxd, mfgl, 101 ohms ±2%, 3 w	
R12	0766-0029	R: fxd, mfgl, 10 ohms ±2%, 3 w	
R13, R14	0766-0020	R: fxd, mfgl, 85.5 ohms ±2%, 3 w	
R15, R16	0766-0018	R: fxd, mfgl, 57.3 ohms ±2%, 3 w	
R17, R18	0766-0022	R: fxd, mfgl, 113 ohms ±2%, 3 w	
R19, R20	0766-0016	R: fxd, mfgl, 28.8 ohms ±2%, 3 w	
R21	0766-0021	R: fxd, mfgl, 1420 ohms ±2%, 3 w	
R22	0766-0019	R: fxd, mfgl, 2150 ohms ±2%, 3 w	
R23	0766-0023	R: fxd, mfgl, 1050 ohms ±2%, 3 w	
R24	0766-0017	R: fxd, mfgl, 4330 ohms ±2%, 3 w	
R25 thru R32		Factory selected part, may be omitted	
R33 thru R35		Not assigned	
R36, R37		Factory selected part, may be omitted	
R38, R39		Not assigned	
R40, R41		Factory selected part, may be omitted	
S1		Nsr; part of A1	
S2		Nsr; part of A2	
		MODEL 350D	
A1	350D-34B	Assy, attenuator, 0-100 db, includes: R1 thru R12, R25 thru R32, S1	
A2	350D-34A	Assy, attenuator, 0-10 db, includes: R13 thru R24, R36 thru R43, S2	
C1	0170-0022	C: fxd, my, 0.1 μf ±20%, 600 vdcw	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

REFERENCE DESIGNATION	℗ STOCK NO.	DESCRIPTION	NOTE
		MODEL 350D (Cont'd)	
J1		Connector: INPUT, includes:	
	5060-0634	Assy, binding post: red	
	5060-0635	Assy, binding post: black	
	0340-0086	Insulator, binding post: 2 hole (outside)	
	0340-0090	Insulator, binding post: 2 hole, keyed (inside)	
	120A-47A	Spacer: binding post	
J2		Connector: OUTPUT, includes:	
	5060-0634	Assy, binding post: red	
	5060-0635	Assy, binding post: black	
	0340-0086	Insulator, binding post: 2 hole (outside)	
	0340-0090	Insulator, binding post: 2 hole, keyed (inside)	
R1	0775-0002	R: fxd, mfgl, 563 ohms ±2%, 7 w	
R2	0766-0013	R: fxd, mfgl, 563 ohms ±2%, 3 w	
R3	0772-0001	R: fxd, mfgl, 312 ohms ±2%, 5 w	
R4	0766-0009	R: fxd, mfgl, 312 ohms ±2%, 3 w	
R5	0775-0001	R: fxd, mfgl, 491 ohms ±2%, 7 w	
R6	0766-0011	R: fxd, mfgl, 491 ohms ±2%, 3 w	
R7	0775-0003	R: fxd, mfgl, 588 ohms ±2%, 7 w	
R8	0766-0015	R: fxd, mfgl, 588 ohms ±2%, 3 w	
R9	0772-0002	R: fxd, mfgl, 422 ohms ±2%, 5 w	
R10	0766-0012	R: fxd, mfgl, 38 ohms ±2%, 3 w	
R11	0766-0010	R: fxd, mfgl, 120 ohms ±2%, 3 w	
R12	0766-0014	R: fxd, mfgl, 12 ohms ±2%, 3 w	
R13, R14	0766-0005	R: fxd, mfgl, 103 ohms ±2%, 3 w	
R15, R16	0766-0003	R: fxd, mfgl, 68.8 ohms ±2%, 3 w	
R17, R18	0766-0007	R: fxd, mfgl, 136 ohms ±2%, 3 w	
R19, R20	0766-0001	R: fxd, mfgl, 34.5 ohms ±2%, 3 w	
R21	0766-0006	R: fxd, mfgl, 1700 ohms ±2%, 3 w	
R22	0766-0004	R: fxd, mfgl, 2580 ohms ±2%, 3 w	
R23	0766-0008	R: fxd, mfgl, 1260 ohms ±2%, 3 w	
R24	0766-0002	R: fxd, mfgl, 5200 ohms ±2%, 3 w	
R25 thru R32		Factory selected part, may be omitted	
R33 thru R35		Not assigned	
R36, R37		Factory selected part, may be omitted	
R38, R39		Not assigned	
R40, R41		Factory selected part, may be omitted	
S1		Nsr; part of A1	
S2		Nsr; part of A2	

See introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

REFERENCE DESIGNATION	℗ STOCK NO.	DESCRIPTION	NOTE
		MISCELLANEOUS	
	5060-0705	Assy, cover: half recess (top)	
	5060-0727	Assy, foot	
	5000-0710	Cover (bottom)	
	5000-0702	Cover, 6 x 8 (side)	
	5060-0702	Frame, side: 6 x 8	
	0370-0112	Knobs	
	00350-90202	Manual: instruction (350C/D)	
	350C-2A	Panel: front (350C only)	
	350D-2A	Panel: front (350D only)	
	350C-2B	Panel: rear	
	2460-0008	Screw: phillips head for rear of top cover	
	2370-0020#	Screw: phillips head for side panels	
	1490-0031	Stand: tilt	
	350C-55A	10 db shield	
	350C-12A	10 db shield clamp	
	350C-55B	100 db shield	
	350C-12B	100 db shield clamp	
	# If screw with nut is used, these are the stock numbers:		
	2420-0004	Nut: hex, w/lock	
	2370-0013	Screw: phillips head for side panel	

See introduction to this section

Table 6-2. Replaceable Parts

STOCK NO.	DESCRIPTION	MFR	MFR PART NO.	TQ	
120A-47A	Spacer: binding post	28480	120A-47A	1	
350C-2A	Panel: front (350C only)	28480	350C-2A	1	
350C-2B	Panel: rear	28480	350C-2B	1	
350C-12A	10 db shield clamp	28480	350C-12A	1	
350C-12B	100 db shield clamp	28480	350C-12B	1	
350C-34A	Assy, attenuator, 0-10 db, includes: R13 thru R24, R36 thru R43, S2	28480	350C-34A	1	
350C-34B	Assy, attenuator, 0-100 db, includes: R1 thru R12, R25 thru R32, S1	28480	350C-34B	1	
350C-55A	10 db shield	28480	350C-55A	1	
350C-55B	100 db shield	28480	350C-55B	1	
350D-2A	Panel, front (350D only)	28480	350D-2A	1	
350D-34A	Assy, attenuator, 0-10 db, includes: R13 thru R24, R36 thru R43, S2	28480	350D-34A	1	
350D-34B	Assy, attenuator, 0-100 db, includes: R1 thru R12, R25 thru R32, S1	28480	350D-34B	1	
0170-0022	C: fxd, my, 0.1 μf ±20%, 600 vdcw	84411	HEW 7	2	
0340-0086	Insulator, binding post: 2 hole (outside)	28480	0340-0086	2	
0340-0090	Insulator, binding post: 2 hole, keyed (inside)	28480	0340-0090	2	
0370-0112	Knob: bar w/arrow, black	28480	0370-0112	2	
0766-0001	R: fxd, mfgl, 34.5 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0002	R: fxd, mfgl, 5200 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0003	R: fxd, mfgl, 68.8 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0004	R: fxd, mfgl, 2580 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0005	R: fxd, mfgl, 103 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0006	R: fxd, mfgl, 1700 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0007	R: fxd, mfgl, 136 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0008	R: fxd, mfgl, 1260 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0009	R: fxd, mfgl, 312 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0010	R: fxd, mfgl, 120 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0011	R: fxd, mfgl, 491 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0012	R: fxd, mfgl, 38 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0013	R: fxd, mfgl, 563 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0014	R: fxd, mfgl, 12 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0015	R: fxd, mfgl, 588 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0016	R: fxd, mfgl, 28.8 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0017	R: fxd, mfgl, 4330 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0018	R: fxd, mfgl, 57.3 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0019	R: fxd, mfgl, 2150 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0020	R: fxd, mfgl, 85.5 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0021	R: fxd, mfgl, 1420 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0022	R: fxd, mfgl, 113 ohms ±2%, 3 w	07115	LPI-3, obd#	2	
0766-0023	R: fxd, mfgl, 1050 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0024	R: fxd, mfgl, 260 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0025	R: fxd, mfgl, 101 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0026	R: fxd, mfgl, 409 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0027	R: fxd, mfgl, 31.7 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0028	R: fxd, mfgl, 469 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0029	R: fxd, mfgl, 10 ohms ±2%, 3 w	07115	LPI-3, obd#	1	
0766-0030	R: fxd, mfgl, 490 ohms ±2%, 3 w	07115	LPI-3, obd#	1	

See introduction to this section

Table 6-2. Replaceable Parts (Cont'd)

STOCK NO.	DESCRIPTION	MFR	MFR PART NO.	TQ	
0772-0001	R: fxd, mfgl, 312 ohms ±2%, 5 w	07115	LPI-5, obd#	1	
0772-0002	R: fxd, mfgl, 422 ohms ±2%, 5 w	07115	LPI-5, obd#	1	
0772-0003	R: fxd, mfgl, 260 ohms ±2%, 5 w	07115	LPI-5, obd#	1	
0772-0004	R: fxd, mfgl, 351 ohms ±2%, 5 w	07115	LPI-5, obd#	1	
0775-0001	R: fxd, mfgl, 491 ohms ±2%, 7 w	07115	LPI-7, obd#	1	
0775-0002	R: fxd, mfgl, 563 ohms ±2%, 7 w	07115	LPI-7, obd#	1	
0775-0003	R: fxd, mfgl, 588 ohms ±2%, 7 w	07115	LPI-7, obd#	1	
0775-0004	R: fxd, mfgl, 409 ohms ±2%, 7 w	07115	LPI-7, obd#	1	
0775-0005	R: fxd, mfgl, 469 ohms ±2%, 7 w	07115	LPI-7, obd#	1	
0775-0006	R: fxd, mfgl, 490 ohms ±2%, 7 w	07115	LPI-7, obd#	1	
1490-0031	Stand: tilt	28480	1490-0031	1	
2370-0013	Screw, phillips head for side panel	28480	2370-0013	8	
2370-0020	Screw, phillips head for side panel	28480	2370-0020	8	
2420-0004	Nut: hex, w/lock	28480	2420-0004	8	
2460-0008	Screw, phillips head for rear of top cover	28480	2460-0008	1	
5000-0702	Cover: 6 x 8 (side)	28480	5000-0702	2	
5000-0710	Cover (bottom)	28480	5000-0710	1	
5060-0634	Assy, binding post: red	28480	5060-0634	2	
5060-0635	Assy, binding post: black	28480	5060-0635	3	
5060-0702	Frame: side, 6 x 8	28480	5060-0702	2	
5060-0705	Assy, cover: half recess (top)	28480	5060-0705	1	
5060-0725	Assy, foot	28480	5060-0725	2	
5060-0727	Assy, foot	28480	5060-0727	2	
00350-90202	Manual, instruction (350C/D)	28480	00350-90202	1	

See introduction to this section

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 1 of 2)

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 handbooks.

Code No.	Manufacturer	Address
00000	U.S.A. Common	Any supplier of U.S.
00136	McCoy Electronics	Mount Holly Springs, Pa.
00213	Sage Electronics Corp.	Rochester, N. Y.
00334	Humidail Co.	Colton, Calif.
00335	Westrex Corp.	New York, N.Y.
00373	Garlock Packing Co., Electronic Products Div.	Camden, N.J.
00656	Aerovox Corp.	New Bedford, Mass.
00779	Amp, Inc.	Harrisburg, Pa.
00781	Aircraft Radio Corp.	Boonton, N.J.
00815	Northern Engineering Laboratories, Inc.	Burlington, Wis.
00853	Sangamo Electric Company, Ordill Division (Capacitors)	Marion, Ill.
00866	Goe Engineering Co.	Los Angeles, Calif.
00891	Carl E. Holmes Corp.	Los Angeles, Calif.
01121	Allen Bradley Co.	Milwaukee, Wis.
01255	Litton Industries, Inc.	Beverly Hills, Calif.
01281	TRW Semiconductors Inc.	Lawndale, Calif.
01295	Texas Instruments, Inc. Transistor Products Div.	Dallas, Texas
01349	The Alliance Mfg. Co.	Alliance, Ohio
01561	Chassi-Trak Corp.	Indianapolis, Ind.
01589	Pacific Relays, Inc.	Van Nuys, Calif.
01930	Amerock Corp	Rockford, Ill.
01961	Pulse Engineering Co.	Santa Clara, Calif.
02114	Ferroxcube Corp. of America	Saugerties, N.Y.
02286	Cole Mfg. Co.	Palo Alto, Calif.
02660	Amphenol-Borg Electronics Corp.	Chicago, Ill.
02735	Radio Corp. of America, Semiconductor and Materials Div.	Somerville, N.J.
02771	Vocaline Co. of America, Inc.	Old Saybrook, Conn.
02777	Hopkins Engineering Co.	San Fernando, Calif.
03508	G.E. Semiconductor Products Dept.	Syracuse, N.Y.
03705	Apex Machine & Tool Co.	Dayton, Ohio
03797	Eldema Corp.	El Monte, Calif.
03877	Transitron Electronic Corp.	Wakefield, Mass.
03888	Pyrofilm Resistor Co.	Morristown, N.J.
03954	Air Marine Motors, Inc.	Los Angeles, Calif.
04009	Arrow, Hart and Hegeman Elect. Co.	Hartford, Conn.
04013	Taurus Corp.	Lambertville, N. J.
04062	Elmenco Products Co.	New York, N.Y.
04222	Hi-Q Division of Aerovox	Myrtle Beach, S.C.
04298	Elgin National Watch Co., Electronics Division	Burbank, Calif.
04354	Precision Paper Tube Co.	Chicago, Ill.
04404	Dymec Division of Hewlett-Packard Co.	Palo Alto, Calif.
04651	Sylvania Electric Prods., Inc. Electronic Tube Div.	Mountain View, Calif.
04713	Motorola, Inc., Semiconductor Prod. Div.	Phoenix, Arizona
04732	Filtron Co., Inc., Western Div.	Culver City, Calif.
04773	Automatic Electric Co.	Northlake, Ill.
04777	Automatic Electric Sales Corp.	Northlake, Ill.
04796	Sequoia Wire & Cable Co.	Redwood City, Calif.
04811	Precision Coil Spring Co.	El Monte, Calif.
04870	P. M. Motor Company	Chicago 44, Ill.
05006	Twentieth Century Plastics, Inc.	Los Angeles, Calif.
05277	Westinghouse Electric Corp., Semi-Conductor Dept.	Youngwood, Pa.
05347	Ultronix, Inc.	San Mateo, Calif.
05593	Illumitronic Engineering Co.	Sunnyvale, Calif.
05616	Cosmo Plastic (c o Electrical Spec. Co.)	Cleveland, Ohio
05624	Barber Colman Co.	Rockford, Ill.
05728	Tiffen Optical Co.	Roslyn Heights, Long Island, N.Y.
05729	Metropolitan Telecommunications Corp., Metro Cap. Division	Brooklyn, N.Y.
05783	Stewart Engineering Co.	Santa Cruz, Calif.
05820	Wakefield Engineering Inc.	Wakefield, Mass.
06004	The Bassick Co.	Bridgeport, Conn.
06175	Bausch and Lomb Optical Co.	Rochester, N.Y.
06402	E.T.A. Products Co. of America	Chicago, Ill.
06475	Western Devices, Inc.	Inglewood, Calif.
06540	Amatom Electronic Hardware Co. Inc.	New Rochelle, N. Y.
06555	Beede Electrical Instrument Co., Inc.	Penacook, N.H.
06751	U. S. Semcor Division of Nuclear Corp. of America	Phoenix, Arizona
06812	Torrington Mfg. Co., West Div.	Van Nuys, Calif.
07088	Kelvin Electric Co.	Van Nuys, Calif.
07115	Corning Glass Works Electronic Components Dept.	Bradford, Pa.
07126	Digitran Co.	Pasadena, Calif.
07137	Transistor Electronics Corp.	Minneapolis, Minn.
07138	Westinghouse Electric Corp. Electronic Tube Div.	Elmira, N.Y.
07149	Filmohm Corp.	New York, N. Y.
07233	Cinch-Graphik Co.	City of Industry, Calif.
07261	Avnet Corp.	Los Angeles, Calif.
07263	Fairchild Semiconductor Corp.	Mountain View, Calif.
07322	Minnesota Rubber Co.	Minneapolis, Minn.
07387	The Birtcher Corp.	Los Angeles, Calif.
07700	Technical Wire Products	Springfield, N.J.
07910	Continental Device Corp.	Hawthorne, Calif.
07933	Rheem Semiconductor Corp.	Mountain View, Calif.
07966	Shockley Semi-Conductor Laboratories	Palo Alto, Calif.
07980	Boonton Radio Corp.	Boonton, N.J.
08145	U.S. Engineering Co.	Los Angeles, Calif.
08289	Blinn, Delbert, Co.	Pomona, Calif.
08358	Burgess Battery Co.	Niagara Falls, Ontario, Canada.
08717	Sloan Company	Burbank, Calif.
08718	Cannon Electric Co., Phoenix Div.	Phoenix, Ariz.
08792	CBS Electronics Semiconductor Operations, Div. of C.B.S., Inc.	Lowell, Mass.
08984	Mel-Rain	Indianapolis, Ind.
09026	Babcock Relays, Inc.	Costa Mesa, Calif.
09134	Texas Capacitor Co.	Houston, Texas
09145	Atohm Electronics	Sun Valley, Calif.
09250	Electro Assemblies, Inc.	Chicago, Ill.
09569	Mallory Battery Co. of Canada, Ltd.	Toronto, Ontario, Canada
09664	The Bristol Co.	Waterbury, Conn.
10214	General Transistor Western Corp.	Los Angeles, Calif.
10411	Ti-Tal, Inc.	Berkeley, Calif.
10646	Carborundum Co.	Niagara Falls, N.Y.
11236	CTS of Berne, Inc.	Berne, Ind.
11237	Chicago Telephone of California, Inc.	So. Pasadena, Calif.
11312	Microwave Electronics Corp.	Palo Alto, Calif.
11534	Duncan Electronic, Inc.	Santa Ana, Calif.
11711	General Instrument Corporation Semiconductor Division	Newark, N.J.
11717	Imperial Electronic, Inc.	Buena Park, Calif.
11870	Melabs, Inc.	Palo Alto, Calif.
12136	Philadelphia Handle Co.	Camden, N. J.
12697	Clarostat Mfg. Co.	Dover, N.H.
12859	Nippon Electric Co., Ltd.	Tokyo, Japan
12930	Delta Semiconductor Inc.	Newport Beach, Calif.
13103	Thermalloy	Dallas, Texas
13396	Telefunken (G.M.B.H.)	Hannover, Germany
13835	Midland Mfg. Co.	Kansas City, Kansas
14099	Sem-Tech	Newbury Park, Calif.
14193	Calif. Resistor Corp.	Santa Monica, Calif.
14298	American Components, Inc.	Conshohocken, Pa.
14655	Cornell Dubilier Elec. Corp.	So. Plainfield, N.J.
14960	Williams Mfg. Co.	San Jose, Calif.
15203	Webster Electronics Co. Inc.	Brooklyn, N.Y.
15291	Adjustable Bushing Co.	N. Hollywood, Calif.
15772	Twentieth Century Coil Spring Co.	Santa Clara, Calif.
15909	The Daven Co.	Livingston, N.J.
16037	Spruce Pine Mica Co.	Spruce Pine, N. C.
16352	Computer Diode Corp.	Lodi, N. J.
16688	De Jur-Amsco Corporation	Long Island City 1, N.Y.
16758	Delco Radio Div. of G.M. Corp.	Kokomo, Ind.
17109	Thermonetics Inc.	Canoga Park, Calif.
17474	Tranex Company	Mountain View, Calif.
18486	Radio Industries	Des Plaines, Ill.
18583	Curtis Instrument Inc.	Mt. Kisco, N.Y.
18873	E.I. DuPont and Co., Inc.	Wilmington, Del.
19315	Eclipse Pioneer, Div. of Bendix Aviation Corp.	Teterboro, N.J.
19500	Thomas A. Edison Industries, Div. of McGraw-Edison Co.	West Orange, N.J.
19701	Electra Manufacturing Co.	Kansas City, Mo.
20183	Electronic Tube Corp.	Philadelphia, Pa.
21226	Executive, Inc.	New York, N.Y.
21520	Fansteel Metallurgical Corp.	No. Chicago, Ill.
21335	The Fafnir Bearing Co.	New Britain, Conn.
21964	Fed. Telephone and Radio Corp.	Clifton, N.J.
24446	General Electric Co.	Schenectady, N.Y.
24455	G.E., Lamp Division	Nela Park, Cleveland, Ohio
24655	General Radio Co.	West Concord, Mass.
26365	Gries Reproducer Corp.	New Rochelle, N.Y.
26462	Grobet File Co. of America, Inc.	Carlstadt, N.J.
26992	Hamilton Watch Co.	Lancaster, Pa.
28480	Hewlett-Packard Co.	Palo Alto, Calif.
33173	G.E. Receiving Tube Dept.	Owensboro, Ky.
35434	Lectrohm Inc.	Chicago, Ill.
36196	Stanwyck Corp.	Hawkesbury, Ontario, Canada
37942	P.R. Mallory & Co., Inc.	Indianapolis, Ind.
39543	Mechanical Industries Prod. Co.	Akron, Ohio
40920	Miniature Precision Bearings, Inc.	Keene, N.H.
42190	Muter Co.	Chicago, Ill.
43990	C.A. Norgren Co.	Englewood, Colo.
44655	Ohmite Mfg. Co.	Skokie, Ill.
47904	Polaroid Corp.	Cambridge, Mass.
48620	Precision Thermometer and Inst. Co.	Philadelphia, Pa.
49956	Raytheon Company	Lexington, Mass.
52090	Rowan Controller Co.	Baltimore, Md.
63743	Ward Leonard Electric	Mt. Vernon, N.Y.
54294	Shallcross Mfg. Co.	Selma, N.C.
55026	Simpson Electric Co.	Chicago, Ill.
55933	Sonotone Corp.	Elmsford, N.Y.
55938	Sorenson & Co., Inc.	So. Norwalk, Conn.
56137	Spaulding Fibre Co., Inc.	Tonawanda, N.Y.
56289	Sprague Electric Co.	North Adams, Mass.
59446	Telex, Inc.	St. Paul, Minn.
59730	Thomas & Betts Co.	Elizabeth 1, N.J.
60741	Tripplett Electrical Inc.	Bluffton, Ohio
61775	Union Switch and Signal, Div. of Westinghouse Air Brake Co.	Swissvale, Pa.
62119	Universal Electric Co.	Owosso, Mich.
63743	Ward-Leonard Electric Co.	Mt. Vernon, N.Y.
64959	Western Electric Co., Inc.	New York, N.Y.
65092	Weston Inst. Div. of Daystrom, Inc.	Newark, N.J.
66295	Wittek Manufacturing Co.	Chicago 23, Ill.
66346	Wollensak Optical Co.	Rochester, N.Y.
70276	Allen Mfg. Co.	Hartford, Conn.
70309	Allied Control Co., Inc.	New York, N.Y.
70319	Allmetal Screw Prod. Co., Inc.	Garden City, N.Y.
70485	Atlantic India Rubber Works, Inc.	Chicago, Ill.
70563	Amperite Co., Inc.	New York, N.Y.
70903	Belden Mfg. Co.	Chicago, Ill.
70998	Bird Electronic Corp.	Cleveland, Ohio
71002	Birnbach Radio Co.	New York, N.Y.
71041	Boston Gear Works Div. of Murray Co. of Texas	Quincy, Mass.
71218	Bud Radio Inc.	Cleveland, Ohio
71286	Camloc Fastener Corp.	Paramus, N.J.
71313	Allen D. Cardwell Electronic Prod. Corp.	Plainville, Conn.
71400	Bussmann Fuse Div. of McGraw-Edison Co.	St. Louis, Mo.
71436	Chicago Condenser Corp.	Chicago, Ill.
71450	CTS Corp.	Elkhart, Ind.
71468	Cannon Electric Co.	Los Angeles, Calif.
71471	Cinema Engineering Co.	Burbank, Calif.
71482	C.P. Clare & Co.	Chicago, Ill.
71590	Centralab Div. of Globe Union Inc.	Milwaukee, Wis.
71616	Commercial Plastics Co.	Chicago, Ill.
71700	The Cornish Wire Co.	New York, N.Y.
71744	Chicago Miniature Lamp Works	Chicago, Ill.
71753	A.O. Smith Corp., Crowley Div.	West Orange, N.J.
71785	Cinch Mfg. Corp.	Chicago, Ill.
71984	Dow Corning Corp.	Midland, Mich.
72092	Eitel-McCullough, Inc.	San Bruno, Calif.
72136	Electro Motive Mfg. Co., Inc.	Willimantic, Conn.
71707	Coto Coil Co., Inc.	Providence, R.I.
72354	John E. Fast & Co.	Chicago, Ill.
72619	Dialight Corp.	Brooklyn, N.Y.
72656	General Ceramics Corp.	Keasbey, N.J.
72699	General Instrument Corp., Semiconductor Div.	Newark, N.J.
72758	Girard-Hopkins	Oakland, Calif.
72765	Drake Mfg. Co.	Chicago, Ill.
72825	Hugh H. Eby Inc.	Philadelphia, Pa.
72928	Gudeman Co.	Chicago, Ill.
72964	Robert M. Hadley Co.	Los Angeles, Calif.
72982	Erie Resistor Corp.	Erie, Pa.
73061	Hansen Mfg. Co., Inc.	Princeton, Ind.
73076	H.M. Harper Co.	Chicago, Ill.
73138	Helipot Div. of Beckman Instruments, Inc.	Fullerton, Calif.
73293	Hughes Products Division of Hughes Aircraft Co.	Newport Beach, Calif.
73445	Amperex Electronic Co., Div. of North American Phillips Co, Inc.	Hicksville, N.Y.
73490	Beckman Helipot Corp.	So. Pasadena, Calif.
73506	Bradley Semiconductor Corp.	Hamden, Conn.
73559	Carling Electric, Inc.	Hartford, Conn.
73682	George K. Garrett Co., Inc.	Philadelphia, Pa.
73734	Federal Screw Prod. Co.	Chicago, Ill.
73743	Fischer Special Mfg. Co.	Cincinnati, Ohio
73793	The General Industries Co.	Elyria, Ohio
73846	Goshen Stamping & Tool Co.	Goshen, Ind.
73899	JFD Electronics Corp.	Brooklyn, N. Y.
73905	Jennings Radio Mfg. Co.	San Jose, Calif.
74276	Signalite Inc.	Neptune, N.J.
74455	J.H. Winns, and Sons	Winchester, Mass.
74861	Industrial Condenser Corp.	Chicago, Ill.
74868	R.F. Products Division of Amphenol-Borg Electronics Corp.	Danbury, Conn.
74970	E.F. Johnson Co.	Waseca, Minn.
75042	International Resistance Co.	Philadelphia, Pa.
75173	Jones, Howard B., Division of Cinch Mfg. Corp.	Chicago, Ill.
75378	James Knights Co.	Sandwich, Ill.
75382	Kulka Electric Corporation	Mt. Vernon, N.Y.
75818	Lenz Electric Mfg. Co.	Chicago, Ill.
75915	Littlefuse Inc.	Des Plaines, Ill.
76005	Lord Mfg. Co.	Erie, Pa.
76210	C.W. Marwedel	San Francisco, Calif.
76433	Micamold Electronic Mfg. Corp.	Brooklyn, N.Y.
76487	James Millen Mfg. Co., Inc.	Malden, Mass.
76493	J.W. Miller Co.	Los Angeles, Calif.
76530	Monadnock Mills	San Leandro, Calif.
76545	Mueller Electric Co.	Cleveland, Ohio.
76854	Oak Manufacturing Co.	Crystal Lake, Ill.
77068	Bendix Pacific Division of Bendix Corp.	No. Hollywood, Calif.
77075	Pacific Metals Co.	San Francisco, Calif.
77221	Phaostran Instrument and Electronic Co.	South Pasadena, Calif.
77250	Phoell Mfg. Co.	Chicago, Ill.
77252	Philadelphia Steel and Wire Corp.	Philadelphia, Pa.
77342	Potter and Brumfield, Div. of American Machine and Foundry	Princeton, Ind.
77630	Radio Condenser Co.	Camden, N.J.
77638	Radio Receptor Co., inc.	Brooklyn, N.Y.
77764	Resistance Products Co.	Harrisburg, Pa.
77969	Rubbercraft Corp. of Calif.	Torrance, Calif.
78189	Shakeproof Division of Illinois Tool Works	Elgin, Ill.
78283	Signal Indicator Corp.	New York, N.Y.
78290	Struthers-Dunn Inc.	Pitman, N.J.
78452	Thompson-Bremer & Co.	Chicago, Ill.
78471	Tilley Mfg. Co.	San Francisco, Calif.
78488	Stackpole Carbon Co.	St. Marys, Pa.
78493	Standard Thomson Corp.	Waltham, Mass.
78553	Tinnerman Products, Inc.	Cleveland, Ohio
78790	Transformer Engineers	Pasadena, Calif.
78947	Ucinite Co.	Newtonville, Mass.
79142	Veeder Root, Inc.	Hartford, Conn.
79251	Wenco Mfg. Co.	Chicago, Ill.
79727	Continental-Wirt Electronics Corp.	Philadelphia, Pa.
79963	Zierick Mfg. Corp.	New Rochelle, N.Y.
80031	Mepco Division of Sessions Clock Co.	Morristown, N.J.
80120	Schnitzer Alloy Products	Elizabeth, N.J.
80130	Times Facsimile Corp.	New York, N.Y.
80131	Electronic Industries Association tube meeting EIA standards	Any brand Washington, D.C.
80207	Unimax Switch, Div. of W.L. Maxson Corp.	Wallingford, Conn.
80223	United Transformer Corp.	New York, N.Y.
80248	Oxford Electric Corp.	Chicago, Ill.
80294	Bourns Laboratories, Inc.	Riverside, Calif.
80411	Acro Div. of Robertshaw Fulton Controls Co.	Columbus 16, Ohio
80486	All Star Products Inc.	Defiance, Ohio
80509	Avery Adhesive Label Corp.	Monrovia, Calif.
80583	Hammerlund Co., Inc.	New York, N.Y.
80640	Stevens, Arnold, Co., Inc.	Boston, Mass.
81030	International Instruments, Inc.	New Haven, Conn.
81073	Grayhill Co.	LaGrange, Ill.
81095	Triad Transformer Corp.	Venice, Calif.
81312	Winchester Electronics Co., Inc.	Norwalk, Conn.

From: FSC. Handbook Supplements
H4-1 Dated DECEMBER 1964
H4-2 Dated MARCH 1962

APPENDIX
CODE LIST OF MANUFACTURERS (Sheet 2 of 2)

Code No.	Manufacturer	Address
81349	Military Specification	.....
81415	Wilkor Products, Inc.	Cleveland, Ohio
81453	Raytheon Mfg. Co., Industrial Components Div., Industr. Tube Operations	Newton, Mass.
81483	International Rectifier Corp.	El Segundo, Calif.
81541	The Airpax Products Co.	Cambridge, Mass.
81860	Barry Controls, Inc.	Watertown, Mass.
82042	Carter Parts Co.	Skokie, Ill.
82142	Jeffers Electronics Division of Speer Carbon Co.	Du Bois, Pa.
82170	Allen B. DuMont Labs, Inc.	Clifton, N.J.
82209	Maguire Industries, Inc.	Greenwich, Conn.
82219	Sylvania Electric Prod. Inc. Electronic Tube Div.	Emporium, Pa.
82376	Astron Co.	East Newark, N.J.
82389	Switchcraft, Inc.	Chicago, Ill.
82647	Metals and Controls, Inc., Div. of Texas Instruments, Inc., Spencer Prods.	Attleboro, Mass.
82866	Research Products Corp.	Madison, Wis.
82877	Rotron Manufacturing Co., Inc.	Woodstock, N.Y.
82893	Vector Electronic Co.	Glendale, Calif.
83053	Western Washer Mfr. Co.	Los Angeles, Calif.
83058	Carr Fastener Co.	Cambridge, Mass.
83086	New Hampshire Ball Bearing, Inc,	Peterborough, N.H.
83125	Pyramid Electric Co.	Darlington, S.C.
83148	Electro Cords Co.	Los Angeles, Calif.
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83315	Hubbell Corp.	Mundelein, Ill.
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83385	Central Screw Co.	Chicago, Ill.
83501	Gavitt Wire and Cable Co., Div. of Amerace Corp.	Brookfield, Mass.
83594	Burroughs Corp., Electronic Tube Div.	Plainfield, N.J.
83740	Eveready Battery	New York, N.Y.
83777	Model Eng. and Mfg., Inc.	Huntington, Ind.
83821	Loyd Scruggs Co.	Festus, Mo.
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99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.
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99707	Control Switch Division, Controls Co. of America	El Segundo, Calif.
99800	Delevan Electronics Corp.	East Aurora, N.Y.
99848	Wilco Corporation	Indianapolis, Ind.
99934	Renbrandt, Inc.	Boston, Mass.
99942	Hoffman Semiconductor Div. of Hoffman Electronics Corp.	Evanston, Ill.
99957	Technology Instrument Corp of Calif.	Newbury Park, Calif.

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J0000	Winchester Electronics, Inc.	Santa Monica, Calif.
0000F	Malco Tool and Die	Los Angeles, Calif.
0000M	Western Coil Div. of Automatic Ind., Inc.	Redwood City, Calif.
0000P	Ty-Car Mfg. Co., Inc.	Holliston, Mass.
0000Z	Willow Leather Products Corp.	Newark, N.J.
000AA	British Radio Electronics Ltd.	Washington, D.C.
000AB	ETA	England
000AC	Indiana General Corp., Elect. Div.	Indiana
000BB	Precision Instrument Components Co.	Van Nuys, Calif.
000MM	Rubber Eng. & Development	Hayward, Calif.
000NN	A "N" D Manufacturing Co.	San Jose 27, Calif.
000QQ	Cooltron	Oakland, Calif.
000SS	Control of Elgin Watch Co.	Burbank, Calif.
000WW	California Eastern Lab.	Burlingame, Calif.
000YY	S.K. Smith Co.	Los Angeles 45, Calif.

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